

10.13. It is not necessary to draw pipe threads with a taper, although a taper of approximately 8 to 1 may be used if desired, but the thread designation must indicate whether straight or taper threads are required.

The notes used to complete the information are of the same general type as those used for screw threads.

Example: 4 - 8 NPT means

- 4 - nominal diameter of pipe
- 8 - number of threads per inch
- N - American Standard
- P - Pipe
- T - Taper thread

The specifications for a 4" pipe having a straight thread would read:

4 - 8 NPS where S means straight thread. The number of threads may be omitted, if desired, as the number of threads per inch on a specific pipe size does not vary.

FASTENER MATERIALS³

Because fasteners are available in virtually any material, design choices are practically unlimited. The key to material selection for fasteners is in knowing what job the fastener has to do, then specifying a material to meet those requirements. Consider these questions:

1. Will the fastener be subjected to a corrosive condition?
2. Will the fastener be used in high temperatures?
3. Is weight important?
4. Should the material be nonmagnetic?
5. Will the fastener be subjected to high vibrations or cyclic fatigue stresses?
6. Does it need good heat or electrical conductivity?
7. What about cost?
8. Is it necessary that the fastener be used over and over again?
9. Should the life expectancy of the fastener match the life expectancy of the device fastened?
10. In what type of industry will the fastener be used?

All of these questions should be considered before selecting a fastener material. In an electric motor, for example, a fastener of a magnetic material could not be used next to the coil. A titanium fastener used with magnesium would cause galvanic corrosion. A zinc-plated fastener should not be used with equipment that will come in contact with food.

The problems of corrosion can be met by using: protective coatings and finishes; non-ferrous, corrosion-resistant alloys; and nonmetallic fasteners.

Fastener finishes and protective coatings should be used only when the fastener is subjected to mildly corrosive conditions. For extremely corrosive conditions, a fastener made of metal that has inherent corrosion resistance should be specified.

Fasteners are being subjected to higher and higher temperatures. In the petroleum and chemical industries, stainless and low-alloy steels are used at temperatures of 1000 F. and higher where severe corrosive conditions exist. Gas turbine engines require fasteners to withstand higher temperatures and stresses.

STEEL

The greatest number of fasteners are made of steel. Standard specifications for ferrous fasteners cover a broad range of mechanical properties. These specifications include a marking system (Figure 10.14), which identifies bolt heads by grade. SAE grades 2, 5, and 8 are most often specified.

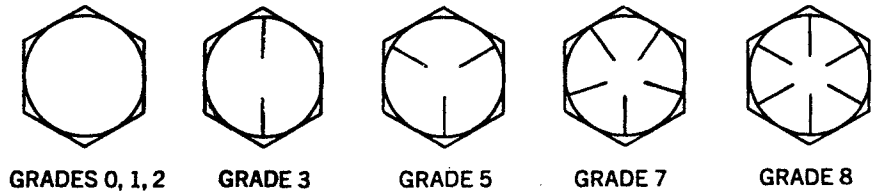


Fig. 10.14 Bolt Head Identification

Courtesy Machine Design, Vol. 37, No. 6, 1965.

DESIGNATION SYSTEM⁴

Bolts are basically graded by numbers where increasing whole numbers represent increasing tensile strength.

Grade 0. Steel bolts without mechanical property requirements.

Grade 1. Commercial steel bolts with a minimum strength of 55,000 psi.

Grade 2. Low carbon steel bolts with minimum tensile strengths of 69,000, 64,000, and 55,000 psi.

Grade 3. Medium carbon, cold worked bolts with minimum tensile strengths of 110,000 and 100,000 psi.

Grade 5. Quenched and tempered, medium carbon steel bolts with minimum tensile strengths of 120,000, 115,000, and 105,000 psi.

Grade 6. Quenched and tempered, medium carbon steel bolts with minimum

tensile strengths of 140,000 and 133,000 psi.

Grade 7. Quenched and tempered, medium carbon steel bolts with threads rolled after heat treatment and with a minimum tensile strength of 133,000 psi.

Grade 8. Quenched and tempered, medium carbon alloy steel bolts with a minimum tensile strength of 150,000 psi.

The most commonly used steels are^a:

SAE 1010. Machine screws, carriage bolts, similar products without critical strength requirements.

SAE 1018, 1020, 1021. Bright cap screws, special items.

SAE 1038. High-strength bolts and cap screws.

SAE 1041, 1045, 1330, and 1340. For special requirements.

SAE 100 Series (Resulfurized). Usually used for nuts, with some also being made from SAE 1016, 1038, and a hot-formed nut from SAE 1045.

ALUMINUM

Aluminum has an entire family of alloys that are the least costly, by volume, of all

the metals. It is easily alloyed with other metals and is widely used as a fastener material. There are two groups of aluminum fasteners, hardenable and nonhardenable.

BRASS

Brass usually is composed of copper, zinc and a hardening agent such as tin. Relatively inexpensive, the brasses have many uses in fastener design. They are easily worked into any shape and possess adequate strength. It will take a high, lustrous finish and is nonmagnetic.

COPPER

Electrolytic, tough-pitch copper is one of the most malleable of all metals. It can be severely formed, and has high corrosion resistance. Electrical conductivity is higher than any other nonprecious metal.

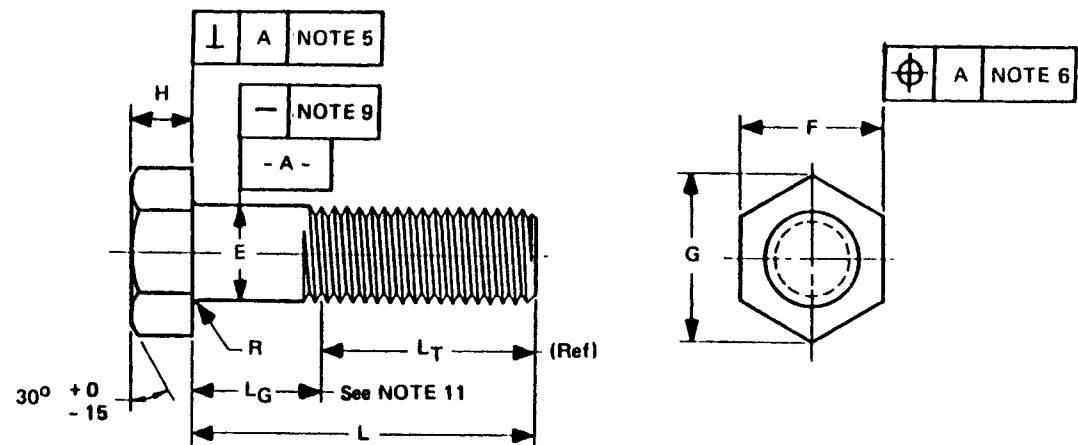


TABLE 2 DIMENSIONS OF HEX BOLTS

Nominal Size or Basic Product Dia (17)	E		F				G		H			R		L _T	
	Body Dia (7)		Width Across Flats (4)				Width Across Corners		Height			Radius of Fillet		Thread Length For Bolt Lengths (11)	
	Max		Basic	Max	Min	Max	Min	Basic	Max	Min	Max	Min	6 in. and shorter	over 6 in.	
	Max	Basic	Max	Min	Max	Min	Basic	Max	Min	Max	Min	Basic	Basic		
1/4	0.2500	0.260	7/16	0.438	0.425	0.505	0.484	11/64	0.188	0.150	0.03	0.01	0.750	1.000	
5/16	0.3125	0.324	1/2	0.500	0.484	0.577	0.552	7/32	0.235	0.195	0.03	0.01	0.875	1.125	
3/8	0.3750	0.388	9/16	0.562	0.544	0.650	0.620	1/4	0.268	0.226	0.03	0.01	1.000	1.250	
7/16	0.4375	0.452	5/8	0.625	0.603	0.722	0.687	19/64	0.316	0.272	0.03	0.01	1.125	1.375	
1/2	0.5000	0.515	3/4	0.750	0.725	0.866	0.826	11/32	0.364	0.302	0.03	0.01	1.250	1.500	
5/8	0.6250	0.642	15/16	0.928	0.906	1.083	1.033	27/64	0.444	0.378	0.06	0.02	1.500	1.750	
3/4	0.7500	0.768	1 1/8	1.125	1.088	1.299	1.240	1/2	0.524	0.455	0.06	0.02	1.750	2.000	
7/8	0.8750	0.895	1 5/16	1.312	1.269	1.516	1.447	37/64	0.604	0.531	0.06	0.02	2.000	2.250	
1	1.0000	1.022	1 1/2	1.500	1.450	1.732	1.653	43/64	0.700	0.591	0.09	0.03	2.250	2.500	
1 1/8	1.1250	1.149	1 11/16	1.688	1.631	1.949	1.859	3/4	0.780	0.658	0.09	0.03	2.500	2.750	
1 1/4	1.2500	1.277	1 7/8	1.875	1.812	2.165	2.066	27/32	0.876	0.749	0.09	0.03	2.750	3.000	
1 3/8	1.3750	1.404	2 1/16	2.062	1.994	2.382	2.273	29/32	0.940	0.810	0.09	0.03	3.000	3.250	
1 1/2	1.5000	1.531	2 1/4	2.250	2.175	2.598	2.480	1	1.036	0.902	0.09	0.03	3.250	3.500	
1 3/4	1.7500	1.785	2 5/8	2.625	2.538	3.031	2.893	1 5/32	1.196	1.054	0.12	0.04	3.750	4.000	
2	2.0000	2.039	3	3.000	2.900	3.464	3.306	1 11/32	1.388	1.175	0.12	0.04	4.250	4.500	
2 1/4	2.2500	2.305	3 3/8	3.375	3.262	3.897	3.719	1 1/2	1.548	1.327	0.19	0.06	4.750	5.000	
2 1/2	2.5000	2.559	3 3/4	3.750	3.625	4.330	4.133	1 21/32	1.708	1.479	0.19	0.06	5.250	5.500	
2 3/4	2.7500	2.827	4 1/8	4.125	3.988	4.763	4.546	1 13/16	1.869	1.632	0.19	0.06	5.750	6.000	
3	3.0000	3.081	4 1/2	4.500	4.350	5.196	4.959	2	2.060	1.815	0.19	0.06	6.250	6.500	
3 1/4	3.2500	3.335	4 7/8	4.875	4.712	5.629	5.372	2 3/16	2.251	1.936	0.19	0.06	6.750	7.000	
3 1/2	3.5000	3.589	5 1/4	5.250	5.075	6.062	5.786	2 5/16	2.380	2.057	0.19	0.06	7.250	7.500	
3 3/4	3.7500	3.858	5 5/8	5.625	5.437	6.495	6.198	2 1/2	2.572	2.241	0.19	0.06	7.750	8.000	
4	4.0000	4.111	6	6.000	5.800	6.928	6.612	2 11/16	2.764	2.424	0.19	0.06	8.250	8.500	